shown in cut. On the left-hand side is a movable pointer, *N*, set daily to show *the normal to that date*, in this case indicating 8.28 inches; while on the right is a similar, adjustable, index, *A*, for the *actual* rainfall to date, set to indicate 7.25 inches, for example. Where permanent exhibits are installed, as now the case at some of the more important stations of the service, at expositions, within boards of trade, street kiosks, etc.,—the same people may frequently pass or examine the data daily. If not already somewhat familiar with meteorological apparatus they very quickly learn to read the instruments, charts, and maps, and with graphic scales of this character, a glance only is necessary to see how the *actual* and the *normal* compare from day to day, as shown by the relative positions of the sliding pointers.

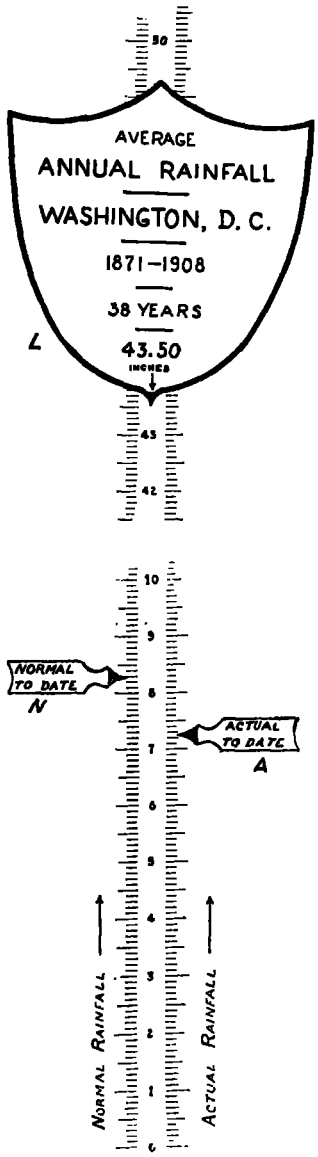

FIG. 1.—Meteorological display device (Maring).

Descriptive legends for conspicuous places such as the kiosks, should always be just as brief and concise as possible, so that even "he who runs" may read. To receive any attention from the average business man these legends should be in large type and in the fewest words; otherwise, he may not stop to read them at all. Increasing interest, however, is sure to develop from daily observations, and those who become especially interested in the subject can always obtain all the details required at the Weather Bureau offices.

In these days when advertising is an art, it is very desirable that the preparation and display of meteorological data be given every consideration, with a view to obtaining the best possible artistic effects, and, at the same time, educate the public to a better understanding of Weather Bureau work.

METEOROLOGICAL REGISTRATIONS IN SAMOA, 1902-1906. III. SUNSHINE.

By OTTO TETENS, Ph.D. Dated, Bensberg, Germany, May 13, 1909.

A Campbell-Stokes sunshine recorder was used, adapted to tropical conditions by mounting it on an adjustable board. During the first and last half-hours of the day the sheet-carrier shaded a part of the glass ball, thus shortening the registration by one hour on bright days. Furthermore the deepest part of the recording sheet was, by its concavity, able to collect some rain water which possibly prevented exact sunshine records once or twice about noon. Although the model used can not be recommended for a tropical station, still the records obtained can be reduced so that they are free from the defects of the instrument. Owing to the principal fault one hour was subtracted from the length of day in order to compute the true percentage of sunshine from the daily amount recorded. In the resulting percentage for days without clouds as known by eye observations 100 is given.

ANNUAL PERIOD.

Table 1 shows the monthly results for the years 1905 and 1906. During January, 1905, the recorder did not work satisfactorily, therefore the average percentage of the other five wet months of 1905 has been adopted for this month, the value has been placed in ( ).

TABLE 1.—*Insolation at Apia, Samoa*, 1905–1906.

Month.	Monthly.			Daily.		Percentage of possible daily hours.		
	1905.	1906.	Average 1905–06.	Average 1905–06.	Average length of day.	1905.	1906.	Average 1905–06.
	Hours.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	%	%	%
January	(162)	134	(173)	(5.6)	12.7	(45)	51	(48)
February	128	147	137	4.9	12.4	40	46	43
March	146	167	156	5.0	12.0	43	49	46
April	155	181	168	5.6	11.7	48	56	52
May	197	146	171	5.5	11.4	61	45	53
June	173	121	147	4.9	11.2	56	39	48
July	140	158	149	4.8	11.3	44	50	47
August	144	144	144	4.7	11.5	44	44	44
September	176	211	194	6.4	11.9	54	65	59
October	230	194	212	6.8	12.3	66	56	61
November	170	158	164	5.5	12.6	49	45	47
December	157	153	155	5.0	12.8	43	42	42
Annual total	1978	1963	1970	5.4	12.0	49	49	49
Average.								
Dry month	177	162	170	5.5	11.6	54	50	52
Wet month	153	165	159	5.2	12.4	45	48	46

From these figures it is seen that the last two months of the dry season, September and October, show the largest percentage of sunshine, whereas the distribution of the higher and lower values in the other months seems quite irregular. For example, considering the average values of the two years, August (a dry month) shows below 50 per cent of its possible, April (a wet month) above 50 per cent of possible sunshine. The months of May and June present the largest differences between the two years. This is in agreement with the character of these two months as determined by the rain observations.

Mean cloudiness.—For several places the mean cloudiness of the month, *d*, has been computed from the monthly number of clear, *s*, and cloudy, *c*, days, using the formula:

$$d = a + b \cdot \frac{c - s}{n},$$

c = the number of days per month with 25 per cent or less sunshine,

s = the number of days per month with 75 per cent or more sunshine,

n = the number of days per month.

The statistics of the clear and cloudy days are given in Table 2, which presents, in addition, the number of days without any sunshine, or overcast days, *o*.

TABLE 2.—*Number of clear, cloudy, and overcast days, Apia, Samoa, 1905–6.*

Month.	1905.			1906.		
	s.	*c.*	*o.*	*s.*	*c.*	*o.*
January	6	10	3	8	6	1
February	3	10	3	5	9	1
March	7	11	4	8	10	5
April	8	9	4	11	5	2
May	14	5	1	6	8	2
June	8	5	2	4	9	3
July	7	9	1	6	5	2
August	6	9	1	5	9	2
September	9	4	0	17	4	0
October	15	3	0	11	6	2
November	7	10	4	8	9	4
December	3	10	2	2	11	3
Year	93	95	25	91	91	27
Average.						
Dry month	10	6	1	8	7	2
Wet month	6	10	3	7	8	3

The mean cloudiness has been derived according to the usual scale of 0 to 10 from the percentage of sunshine, *p*, using the formula

$$p+10\,d=100.$$

Thus, by the method of least squares, from the single monthly values of *s*, *c*, and *d* the following results for the coefficients *a* and *b* have been derived:

$$a=5.07,\ b=3.70.$$

It has been found that for Germany $a=5.1$ and $b=5.0$; therefore, the fluctuations of $c-s$, corresponding to certain fluctuations of *d*, are much larger in Samoa than they are in Germany.

The foot of Table 2 shows that in both years the average dry month embraced exactly as many clear days, as the average wet month embraced cloudy ones, and vice versa. Consequently in considering the annual amounts, the clear days appear as often as the cloudy ones, each being about 25 per cent of all days, i. e., exactly the percentage of degrees of sunshine embraced by the two classes according to their definition. This very even distribution of the different grades of cloudiness seems to be a remarkable feature of the climate of Samoa.

The annual number of days without any sunshine is about 26, or 7 per cent of all days. During the wet season the percentage is 10 and during the dry season only 4.

DAILY PERIOD.

In considering the average values for 1905–6 in the majority of the months the maximum sunshine occurs during the morning hours from 9^a–12^a, except the months of January (10^a–1^p), February (8^a–9^a), and May (12^a–1^p). The average maximum hour for the year as well as for the two seasons is from 10^a–11^a; this can be seen from Table 3.

TABLE 3.—*Average hourly percentages of sunshine, Apia, Samoa, 1905–6.*

Hours ending	Year.	Seasonal.	
		Dry.	Wet.
	%	%	%
7 a. m.	10(19)	6(19)	14(20)
8 a. m.	42	35	48
9 a. m.	57	58	57
10 a. m.	62	64	60
11 a. m.	63	65	62
12 m.	62	65	58
Sum, a. m.	296	293	299
1 p. m.	60	62	57
2 p. m.	54	58	51
3 p. m.	49	52	46
4 p. m.	42	46	38
5 p. m.	33	34	29
6 p. m.	9(18)	8(28)	10(14)
Sum, p. m.	246	260	231
Difference a. m.–p. m.	50	33	68

Regarding the figures for the hours ending 7 a. m. and 6 p. m., when compared with different months or seasons, or in comparison with the other hours of the day, it must be remembered that even on cloudless days the sunshine can be recorded only during a part of these hours. The maximum possible sunshine for these hours varies with the day's length from January (0.86 hour), June and July (0.12 hour), to December (0.90 hour). The average for the year is 0.50, for the dry months 0.29, and for the wet months 0.69 hour. When the mean cloudiness is to be computed from the hourly sunshine percentage, the figures for the two hours mentioned have to be divided by these fractions according to the different months of seasons. In Table 3 the figures thus obtained are added in curves. Thus during the wet season the sunshine of the early morning hours predominates a little over the dry season. Evidently during the wet months the higher altitude of the sun from 7 to 8 a. m. helps the sun to overcome the absorption produced by the lower strata, while in the dry season the sunshine predominates in the evening hours.

The diurnal maximum of sunshine is in accordance with the diurnal minimum of rain, which in Samoa occurs from 12 to 1 p. m. during the dry season, and during the wet season from 10 to 11 a. m. (quantity and intensity of rain), or 11 to 12 a. m. (duration of rain). Generally, the time of the diurnal rain minimum is a little later than the sunshine maximum. The total amount of forenoon sunshine of every month is greater than that of the afternoon. The months of May and June show a slight difference, but February and December more than one hour. The difference for the two seasons as well as for the year is given at the foot of the table, the average for the year is 0.50 hour.

THE SEASONS AND THE MEAN DAILY MINIMUM AT MEXICO, MO.

By GEORGE REEDER, Section Director. Dated Columbia, Mo., September 23, 1909.

It seems never to have been definitely determined upon what temperature the seasons depend, that is, at what temperature and corresponding date does spring open? When is the flood time of summer? the opening of autumn? the beginning of and the minimum cold of winter? Some writers[1] say that spring begins when the temperature reaches 44° F., but this does not seem to correspond to any distinct epoch in biological phenomena. As a rule, Nature's signs are well advanced before we begin to take notice of them. "The sap has begun to run," insect life is stirring, the brown sod is showing green, and then we say that spring is here. But the processes of life had already renewed their activity before these signs appeared; at just what time does that "mysterious touch of Nature" take place in the early spring?

A study of the mean annual or normal temperature of a place gives no satisfactory answer to this query, but the mean daily temperatures and particularly the mean daily minima present very interesting features. The present paper presents graphically in figs. 1 to 4, the results of the daily maximum and minimum temperatures recorded at Mexico, Audrain County, Mo., during the thirty years 1878 to 1907. A similar study and compilation for the seventeen years of records at Columbia, Boone County, Mo., gave results that agree in all essential points, but the daily irregularities are of course less marked in the means from the longer record at Mexico. The same figures present graphically the arithmetical sums of the rainfalls on each day for the whole thirty years.

In Missouri the seasons are particularly well marked, and both Mexico and Columbia afford very satisfactory points for

[1] Hann defines "winter days" as those days on which the temperature does not rise above freezing even in the afternoon, and "summer days" as those on which the afternoon temperature reaches or exceeds 25° C. (77° F.) (Hann-Ward: Climatology, p. 28). According to this definition, Mexico Mo., has but few winter days, if any.—*C. A., jr.*